

green committee, preferably its chairman. But if he is an honest-to-goodness turfnut he will be the whole committee whether he is on it or not.

Estimating the worth of a turfnut to a golf club is like putting a dollar sign on sunshine and summer showers. But go to any golf course which possesses outstanding merit and you will find somewhere around the grounds its turfnut, for it will surely have one, busily engaged in studying the troubles of the day. The turfnut fills a place not covered by experts, architects, greenkeepers, or confidential advisers. Through him more than through all of these has real progress been made in the technique of growing fine turf. It was he who invented the slogan "replace divots."

The Control of White Grubs on Golf Links

W. R. WALTON

The turf of golf links, both on the fairways and the greens, frequently is attacked and sometimes severely injured by white grubs. These voracious insects devour the roots and underground stems of the grasses, cutting them completely off and causing the grass to dry up and die in patches which may be of small size, but which occasionally aggregate acres in extent.

Golf links which include deciduous woodlands are most liable to attack, because the May beetles, which are the parents of the grubs, are attracted to and feed upon the foliage of such trees, afterwards laying their eggs in the sodlands contiguous to these trees. May beetles, which are strictly nightflying insects, feed principally upon the oak, hickory, poplar, elm, willow, locust, hackberry, ash and walnut, although a few species are known to be attracted to conifers. Practically all of the most injurious species of white grubs spend two full summers feeding beneath the surface of the soil, and the complete life cycle consumes three years. In the most northerly states the life cycle may be as long as four years, or be reduced to as little as two years in the extreme south.

The eggs of the May beetle are deposited in the soil usually on rising ground. They hatch some three or four weeks later and the young white grubs feed during the first season on decaying and living vegetation in the soil. The injuries caused by these at this time are comparatively slight and often escape notice. In the fall white grubs penetrate deeply into the ground and remain inactive until the following spring when they once more approach the surface and begin to feed in earnest on living vegetation. From May to September or October of this second year is the period during which the grubs do their greatest injury to grasslands. At this time they are comparatively close to the surface of the soil and easily may be reached by insecticidal treatments of the character hereinafter described. During the colder months of the year, from October to the following May, the grubs are inaccessible to exterminative measures, and it will be a waste of labor to attempt to eradicate them at that season. A possible exception to this rule may be found in the extreme southern states where the white grubs have been but little studied and are less troublesome than in the north.

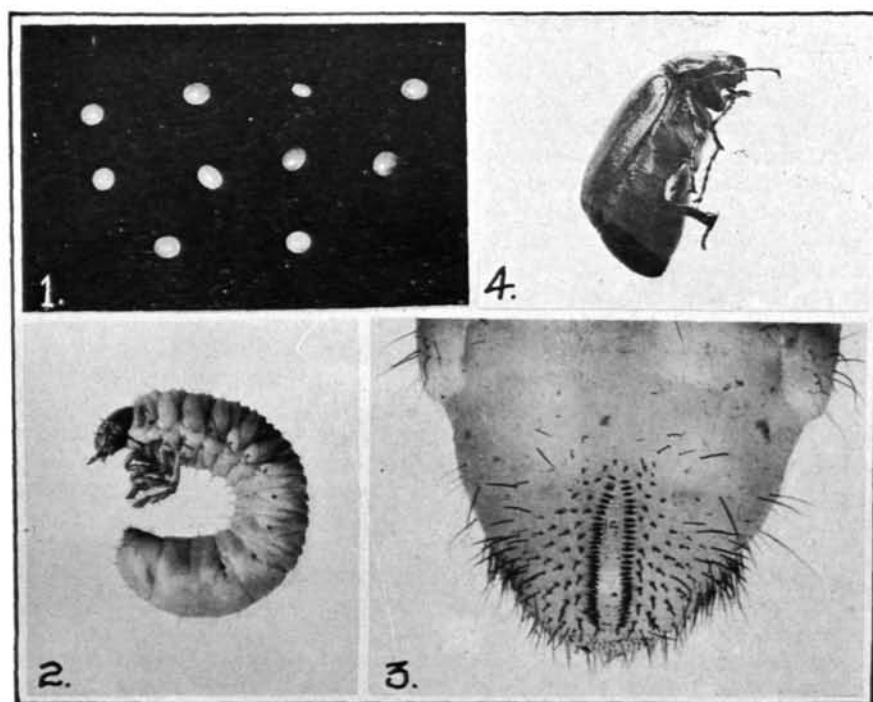
Control Measures

Since golf links consist for the most part of lands that are permanently in grass, the ordinary beneficial cultural practices of the farm, such as rotation of crops, are impracticable as methods of control. It becomes necessary, therefore, to resort to the application of insecticides to destroy the insect in either the grub or adult stage.

Spraying the food trees of the adult beetles with arsenate of lead, two pounds to fifty gallons of water, is effective but requires the employment of a high-power spraying apparatus, fitted with the Worthley solid-stream nozzle. The purchase of such machinery in most cases will not be found advisable because of the expense involved, but in some locations arrangements might be made with commercial spraying concerns or municipal authorities to undertake the work at a cost that need not prove prohibitive.

Collecting beetles from their food trees by jarring such trees while the beetles are feeding at night, having first spread cloth sheets under the trees to catch the fallen beetles, has been practiced in Europe and might be found of service in this country under some conditions.

Experiments conducted recently by Mr. R. H. Van Zwaluwenburg, of the Bureau of Entomology, U. S. Department of Agriculture, on the links of the Merion Cricket Club in Philadelphia, have shown that the grubs may be very efficiently controlled, with apparently complete safety to the



Photographs by J. J. Davis.

Fig. 1. Eggs of a May beetle; they grow after being laid. The small one in top row is freshly laid. Fig. 2. A full grown white grub. (Photo about twice natural size.) Fig. 3. Under side of the tail of a white grub, showing double row of heavy spines. Most harmless grubs lack these spines. Fig. 4. Side view of a May beetle, the parent of the white grub.

grass, by the application of a solution of cyanide of soda (sodium cyanide). This extremely poisonous chemical was applied in a solution of 160 pounds of sodium cyanide to 12,000 gallons of water. The amount named is ample for about one acre. This formula was adapted from the work of Mr. J. J. Davis as used for the destruction of the Japanese beetle, a related species which is being combated in New Jersey under the direction of Dr. A. L. Quaintance, of the Federal Bureau of Entomology.

In the case of comparatively small areas where it is desired to prepare lesser amounts of the solution, Mr. Van Zwaluwenburg has suggested the following: sodium cyanide, 10½ ounces; water, 50 gallons. Apply one quart of the solution per square foot of infested grassland with an ordinary hand sprinkler. Where it becomes necessary to treat extensive areas the use of a 600-gallon tank sprinkler, fitted with a 3-inch pipe 7½ feet long, running across the back of the tank, is advised. The sprinkler pipe should be pierced with three rows of ⅜-inch holes, 12 to the row, or 48 to the foot. With this equipment the proper dosage may be applied by driving the sprinkling apparatus at a walking pace, or about 4 miles per hour.

Among the other insecticides tried by Mr. Van Zwaluwenburg were carbon disulphide, sodium fluoride, and kerosene-fusel-oil soap emulsion. The carbon disulphide was effective when injected into the soil at the rate of from 1 to 2 ounces per square foot, but burned the grass severely around the points of injection. Sodium fluoride, dusted on the surface at the rate of 1 ounce per square foot, was ineffective and killed the grass. The kerosene-fusel-oil soap emulsion gave variable results of from 1½ to 69 per cent kill and was safe even at 10 per cent strength when watered immediately after treatment. In no case, however, did it approach the effectiveness of the sodium cyanide applied as formerly described.

There is one thing regarding the use of sodium cyanide which can not be too strongly impressed upon the minds of those who expect to use this chemical, namely: that it is one of the most *powerful and deadly poisons known to man* and must be handled with corresponding care and discretion. Prof. J. J. Davis is authority for the statement that when applied as described at the rate of 165 pounds per acre, it disappears from the soil within ten days to two weeks. He also states that it sometimes burns the grass slightly where the solution stands on the surface for any length of time, although no effect of this character was noted during the Philadelphia tests. The cost of application at the Merion Club links was roughly estimated by Mr. Van Zwaluwenburg as from \$75 to \$90 per acre, including the labor. The cost of the cyanide alone was from \$48 to \$56 for one acre, estimating 160 pounds to the acre. These figures may seem rather high, but when one considers the effectiveness of the application and the small areas which under ordinary circumstances would require treatment, the cost involved becomes of small importance.

Kerosene emulsion usually is effective as a means of destroying white grubs where they are very close to the surface of the soil. In case it is desired to try this method, the standard formula for its preparation is as follows:

One-half pound of hard soap or 1 quart of soft soap, preferably fish-oil, rosin-soda, or rosin-potash soap, is dissolved in 1 gallon of boiling water, and while hot 2 gallons of kerosene are added and the mixture thoroughly emulsified. This may be done most easily and thoroughly by churning for

about 10 minutes with a spray pump, the nozzle being turned back into the liquid. When thoroughly emulsified the preparation will have the consistency of thick cream, and the oil will not separate. Danger of injuring plants is great if the mixture is not well and thoroughly made. For a 7½ per cent emulsion add 25 gallons of water to the above stock solution and mix thoroughly. It is desirable to use soft water both for the stock and for diluting, but where this is not obtainable the water should be softened by adding lye or sal-soda. A much better emulsion, apparently more effective and more easily made, is prepared by the use of fusel-oil. It is prepared by dissolving 3½ pounds of fish-oil soap in enough water to make a gallon, adding 1 quart of fusel-oil and then 2 gallons of kerosene. When this is churned thoroughly and emulsified, add 25 gallons of water, to make approximately a 7½ per cent emulsion. After application the emulsion should be washed into the soil by sprinkling copiously with water. Water washes the emulsion from the grass and prevents burning and at the same time permits the insecticide to penetrate more thoroughly into the soil. For small areas an ordinary sprinkling can may be used in applying the emulsion, but for larger areas the use of a force pump will save time and labor, a wide sprinkling-can type of nozzle or "rose" being used, so that the lawn can be uniformly drenched in the shortest possible time.

The Lawn-Mower and Its Care

N. D. PERINE

Much has been written about golf-course construction by well-known architects and engineers telling how deep the subsoil should be and how much top-soil, top-dressing, fertilizer, and humus should be used. The grass expert has written of the kinds of seeds that are best adapted to the various requirements of the course. But very little has ever been told about the tool that is most important and without which the links would be impossible—namely, the lawn-mower.

There are many styles and kinds of lawn-mowers, and, like grass seed, certain varieties are best suited for the greens, certain kinds for the fairways, and others for the tees, approaches, and rough. Different manufacturers employ unlike methods of construction, and various styles made in the same factory are built differently; therefore it is difficult to give any suggestion as to the care of mowers to secure the best results at a minimum cost, except in a general way.

The mower best suited for most greens is of the type that has the seven knives and ball-bearings and can be set to cut as closely as 3/16 inch. This is the general type used on probably two-thirds of the golf courses in this country and on many in England and Scotland.

All mowers when they leave the factory should be properly adjusted for cutting, making it necessary only for the ground-man to attach the handle and to *oil all bearings*. It should always be borne in mind that a lawn-mower is a machine, and like all other machines it requires oil and attention. Do not use a heavy-engine or automobile oil that will gum, but a medium-light household oil, and use it frequently, for it does not last long when the machine is run in the hot sun. Should the bearings become gummed by the use of inferior or heavy oil, pour kerosene into them. It